01217513 ระบบสารสนเทศทางภูมิศาสตร์และการรับรู้ระยะไกล

An Introduction to

3S-technology

Dr.Weerakaset Suanpaga
(D.ENG RS&GIS)

Department of Civil Engineering
Faculty of Engineering , Kasetsart University
Bangkok, Thailand

1

What is 3S-technology or geo-informatics?

GIS = Geographic Information System
RS = Remote Sensing
GPS=Global Positioning System

Introducing you to new vistas of GIS

5

เนื้อหา

- ความรู้เบื้องต้นเกี่ยวกับภูมิสารสนเทศ **(Geo-informatics)** หรือ **3S technology**
- ระบบสารสนเทศทางภูมิศาสตร์ **(Geographic Information System)**
- **Global Positioning System (GPS)**
- การรับรู้ระยะไกล **(Remote Sensing)**

3

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4

Slide 5

An Introduction to
Geographic Information Systems

Introducing you to new vistas of GIS

5

Slide 6
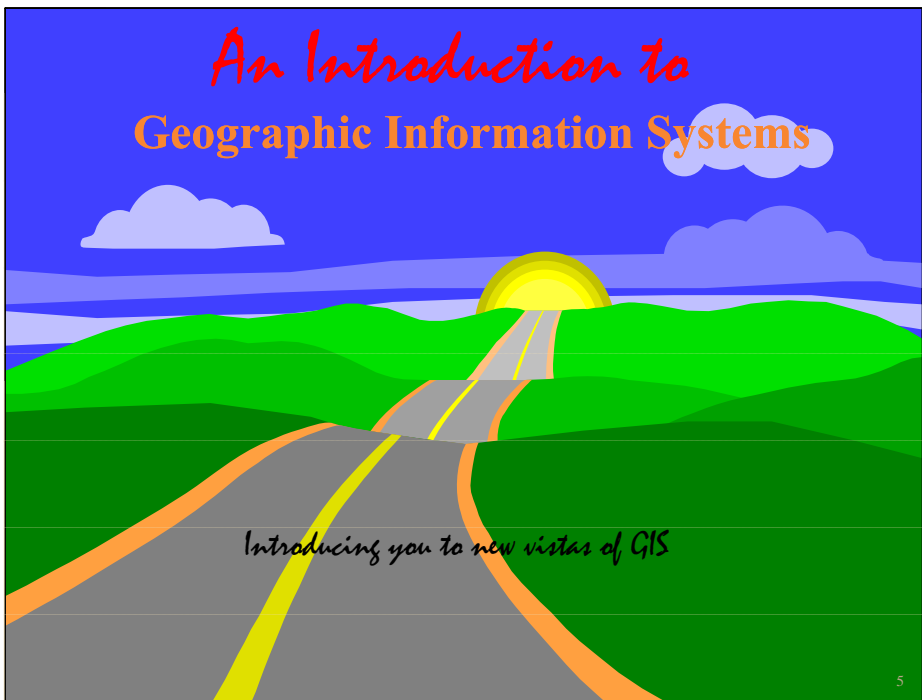
Geographic Information Systems

1. It is an information system that is designed to work with data referenced by spatial or geographic co-ordinates

2. A database system with specific capabilities for spatially-referenced data, as well as a set of operations for working with the data
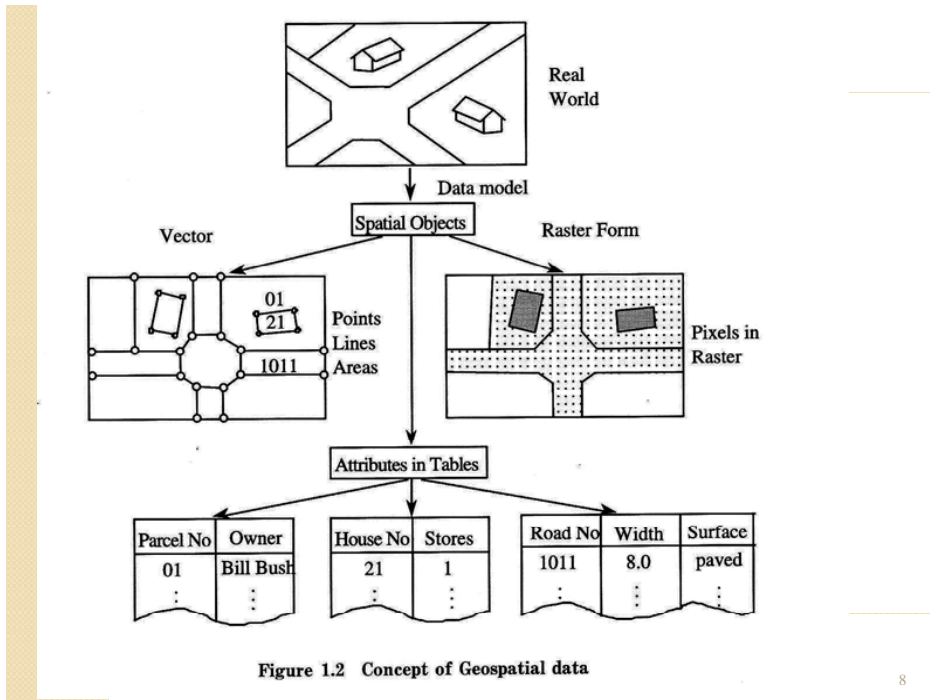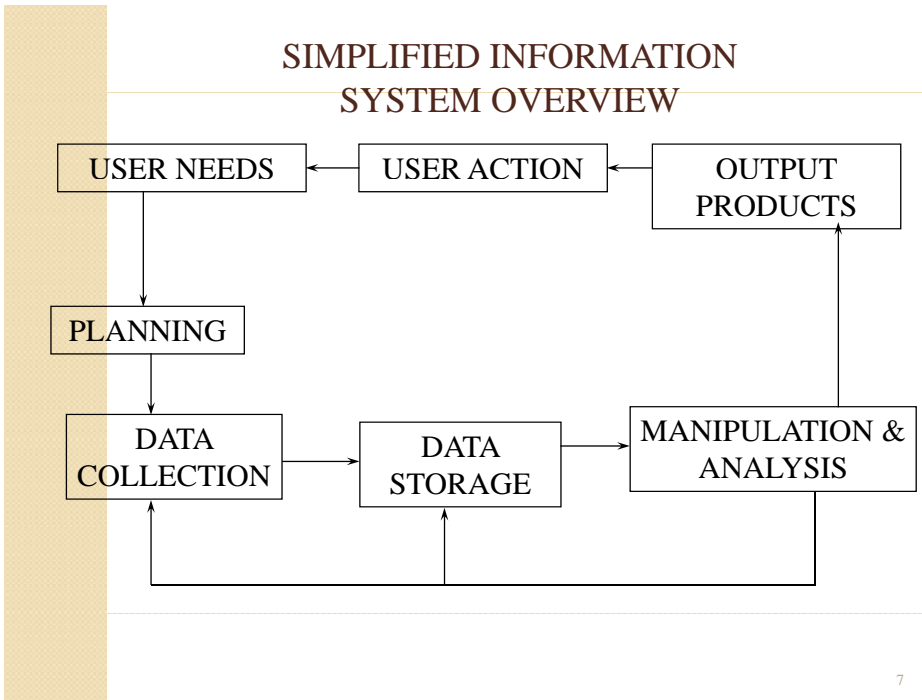
Conclusion : Map & computer

6

Slide 7

SIMPLIFIED INFORMATION SYSTEM OVERVIEW

USER NEEDS ← USER ACTION ← OUTPUT PRODUCTS

USER NEEDS → PLANNING

PLANNING → DATA COLLECTION

DATA COLLECTION → DATA STORAGE → MANIPULATION & ANALYSIS

MANIPULATION & ANALYSIS → OUTPUT PRODUCTS

7

Slide 8

Real World

Data model

Spatial Objects

Vector — Points Lines Areas

Raster Form — Pixels in Raster

01
21
1011

Attributes in Tables

Parcel No	Owner
01	Bill Bush
:	:

House No	Stores
21	1
:	:

Road No	Width	Surface
1011	8.0	paved
:	:	:

Figure 1.2   Concept of Geospatial data

8

Do we need GIS?

Reasons to have a GIS:

- geospatial data are poorly maintained
- maps and statistics are out of date
- data and information are inaccurate
- there is no data retrieval service
- there is no data sharing

Benefits from a GIS :

- geospatial data are better maintained in
  a standard format
- revision and updating are easier
- geospatial data and information are easier to search,
  analyze and represent
- more value added product
- geospatial data can be shared and exchanged freely
- productivity of the staff is improved and more
  efficient
- time and money are saved
- better decisions can be made

Table 1.1   GIS Versus Manual Works

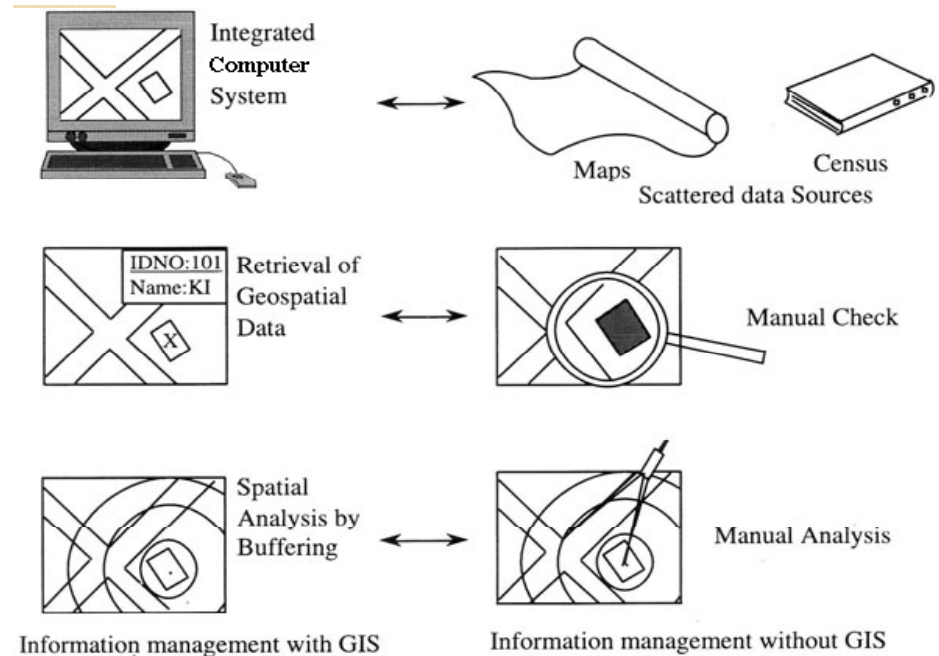| Maps	GIS	Manual Works
Storage Retrieval Updating Overlay Spatial Analysis Display	Standardized and Integrated Digital Data Base Search by Computer Systematically Done Very Fast Easy Cheap and Fast	Different Scales on different Standards Paper Maps, Census, Tables Manual Check Expensiv oand Time Consuming Time & Energy Consuming Complicated Expensive

Figure 1.3   Comparision of Geospatial Information Management

What are the functions of a GIS?

The questions that a GIS is required to answer :

What is at......? (Locational question ; what exists at a particular location)

Where is it.....? (Conditional question ; which locations satisfy certain
conditions)

How has it changed........?
(Trendy question ; identifies geographic occurrence or trends that have changed or in the
process of changing)

Which data are related ....?
(Relational question : analyzes the spatial relationship between objects of
geographic features)

What if.......?
(Model based question ; computers and displays an optimum path, a suitable land,
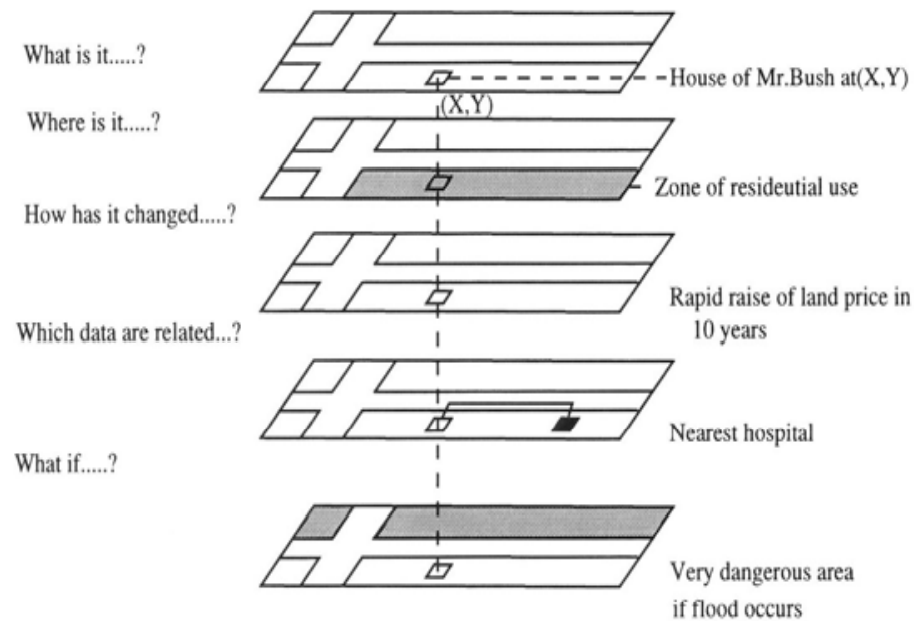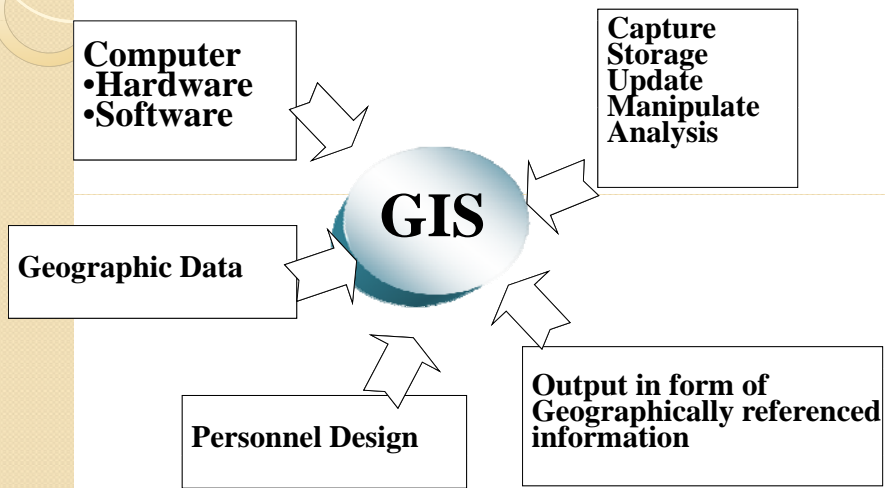risky area against disasters etc. based on model)

Figure 1.4 Required Functions of GIS

Table 1.2 Basic Functions of GIS

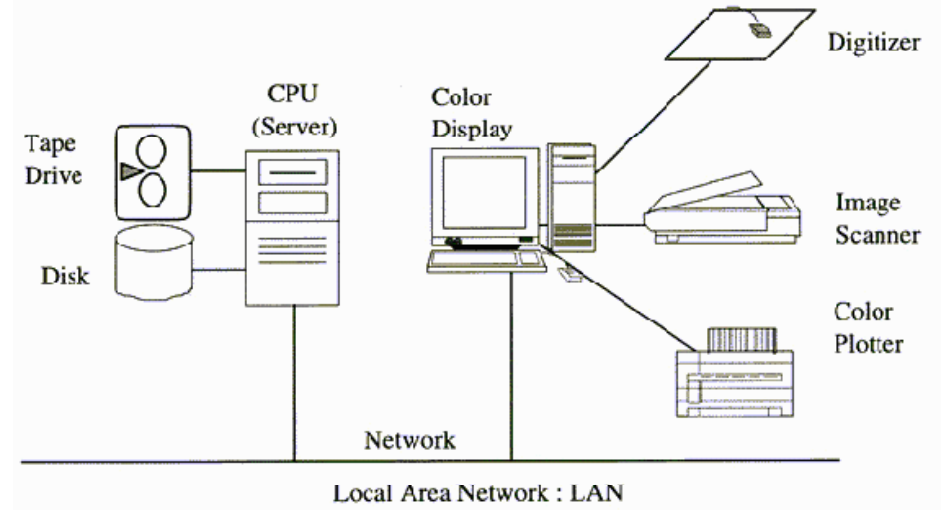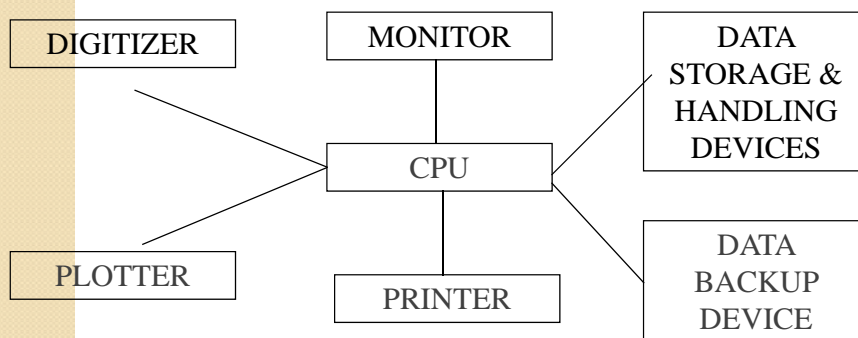| Functions	Sub-functions
Data Aquisition and preprocessing	Digitizing Editing Topology Building Projection Transformation Format Conversion Attribute Assignment etc.
Database Management and Retrieval	Data Archival Hierachical Modeling Network Modeling Relational Modeling Atrribute Querry Object-oriented Database etc.
Spatial Measurement and Analysis	Measurement Operations Buffering Overlay Operations Connectivity Operations etc.
Graphic Output and Visualization	Scale Transformation Generalization Topographic Map Statistical Map 3D Birdís Eye View etc.

Component of GIS

Computer
- **Hardware**
- **Software**

Geographic Data

Personnel Design

GIS

Capture Storage Update Manipulate Analysis

Output in form of Geographically referenced information

17

CPU (Server)

Color Display

Tape Drive

Disk

Digitizer

Image Scanner
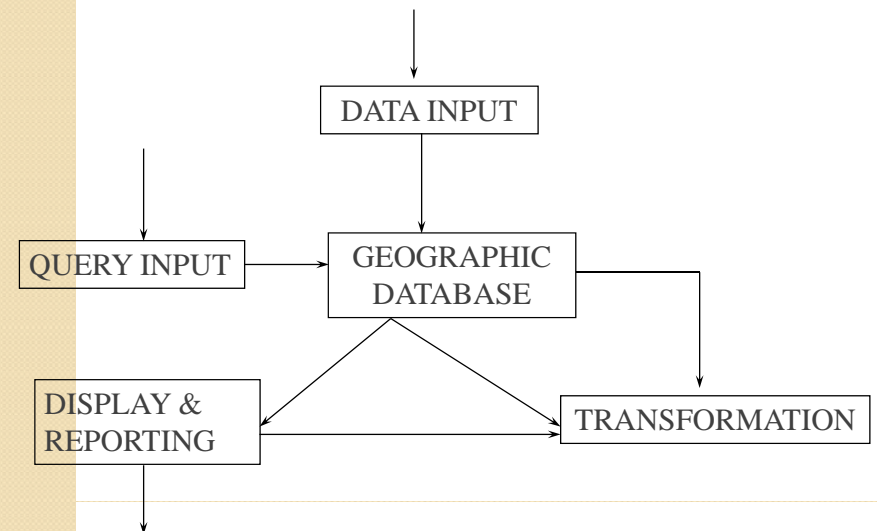
Color Plotter

Network

Local Area Network : LAN

Figure 1.5   Components of GIS Hardward System
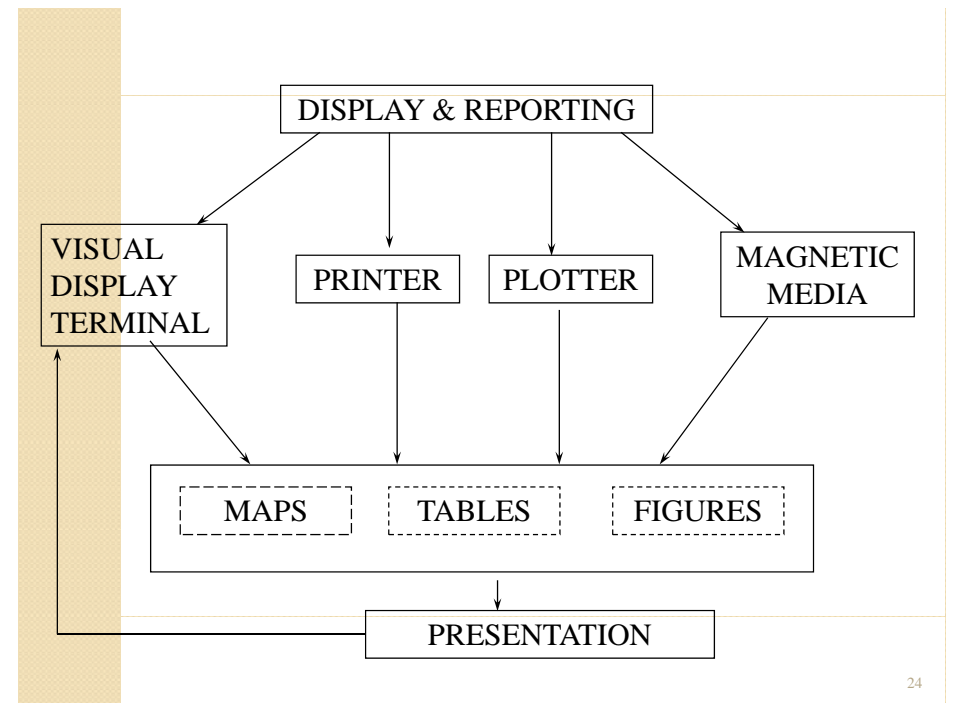
18

Major Hardware Components
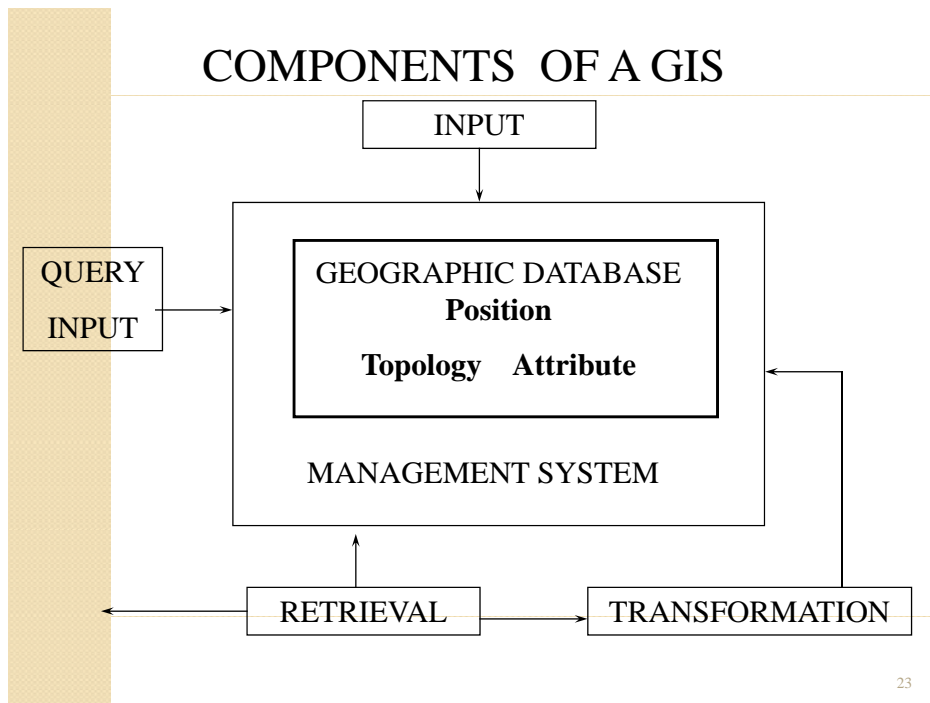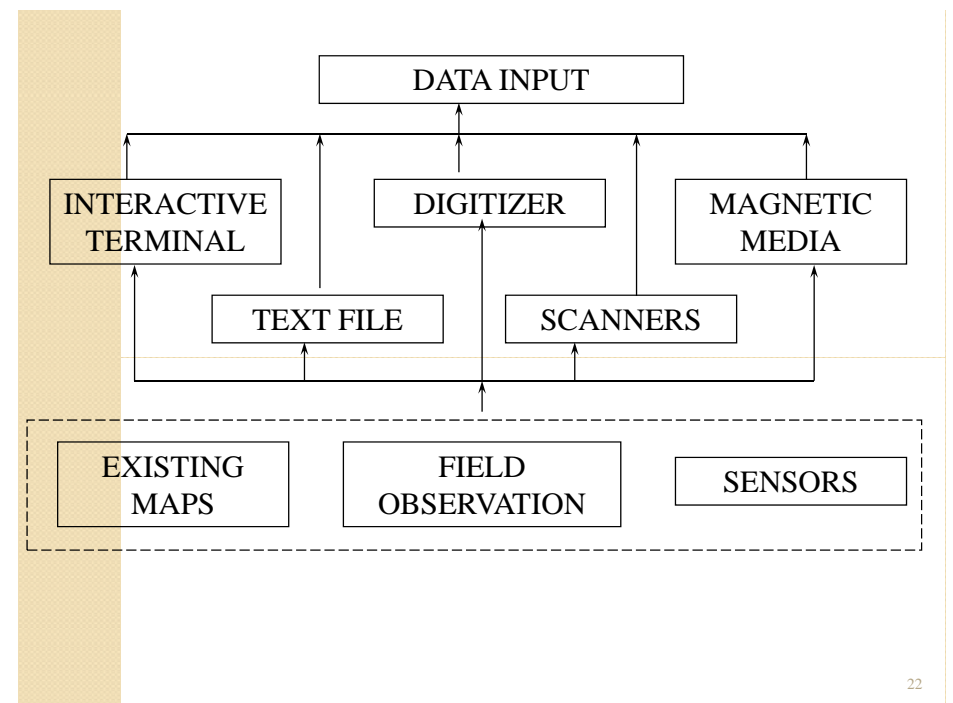
DIGITIZER

MONITOR

DATA STORAGE & HANDLING DEVICES

CPU

PLOTTER

PRINTER

DATA BACKUP DEVICE

19

Major Software Components

DATA INPUT

QUERY INPUT

GEOGRAPHIC DATABASE

DISPLAY & REPORTING

TRANSFORMATION

20

Slide 21:

Data Collection → Data Source

Real World → Data Source

Input of Data

Data Management

Action Taken

USERS

Information for decision making

Analysis ← Data Retrieval & Analysis

21

Slide 22:

DATA INPUT

INTERACTIVE TERMINAL   DIGITIZER   MAGNETIC MEDIA

TEXT FILE   SCANNERS

EXISTING MAPS   FIELD OBSERVATION   SENSORS

22

Slide 23:

COMPONENTS OF A GIS

INPUT

QUERY INPUT

GEOGRAPHIC DATABASE
Position

Topology   Attribute

MANAGEMENT SYSTEM

RETRIEVAL   TRANSFORMATION

23

Slide 24:

DISPLAY & REPORTING

VISUAL DISPLAY TERMINAL   PRINTER   PLOTTER   MAGNETIC MEDIA

MAPS   TABLES   FIGURES

PRESENTATION

24

DATA TRANSFORMATION

```
                    ┌──────────────────────┐
                    │   TRANSFORMATION     │
                    └──────────────────────┘
              ┌──────────────┐    ┌──────────────────────────┐
              │ MAINTENANCE  │    │ UTILIZATION AND ANALYSIS │
              └──────────────┘    └──────────────────────────┘
```

Geographical Concepts

- Spatial Objects - geographic area with associated attributes and characteristics
- Point - a spatial object with no area
  - key attributes : geodetic location other data based on application
- Line - spatial object made of connected sequence of points
  - no width
  - spatial location on either side of the line
- Nodes - intersection of line or end of line segment

- Polygon
  - A Closed Area
  - simple polygon undivided area
  - complex polygon divided area of different characteristics
- Chains
  - special kind of line segment which corresponds to a position of the boundary edge of a polygon
- Scale
  - ratios of distances represented on a map to their true length on the earth's surface
  - dimensionless
  - small scale map (Ex. 1:1,000,000 large area)
  - large scale map (Ex. 1:10,000 large area)

- Resolution : distinguishing individual parts
  - Spatial resolution for geographic data as the content of the geometric domain divided by the number of observations, normalized by spatial dimension
  - (Ex. 2D-dataset Res=$\sqrt{area/inform^2}$)
  - (Ex. 3D-dataset Res=?)
  - Size of the resolution element (Resel) => related to size of objects we can distinguish in a dataset
- Spatial Domain
  - Area covered by the observation
- ☑ More information => mean resolution gets smaller
- ☑ Less information => mean resolution gets larger
- ☑ If information increase and mean resolution element gets smaller => Higher resolution

GIS Functional Elements

- Data Acquisition
- Data Processing
- Data Management
- Data Manipulation and Analysis
- Data Product Generation

Data Acquisition

Process of identifying and gathering the data required for the application.

Data Preprocessing

- Manipulating data in several ways to be able to prepare it for further modeling.
- Converting Format
  - Georeferencing
  - Geometric Correction
  - Resampling
- Establishing a consistent system for recording – Data model

Data Management

- Helps in creating and assessing the database.
- Consistent method for data entry, update, deletion and retrieval.

Data Manipulation and Analysis

- Working within database to derive new information.
- Statistical tool.
- Modeling.
- Logical and Boolean tools.
- Specialized model.

Product Generation

- Soft Copy
- Hard Copy
- Cartographic principles built-in Computer Aided Drafting Tool

Product Presentation

- Report - (Table, Map, Write-up)
- Multimedia

GIS - an integrated multidisciplinary science

Geography   Statistics
Cartography   Operations Research
Remote Sensing   Computer Science
Photogrammetry   Mathematics
Surveying   Civil Engineering
Geodesy   Urban Planning etc.

QuickBird Imagery of Suvarnabhumi Airport and Vicinity acquired on November 21, 2005

Pan-sharpened imagery – Ikonos example

1-Meter Panchromatic Image

1-Meter Pan-Sharpened Image

4-Meter Multispectral Image

Kandleru Creek, AP, India: Data Fusion Image of IRS LISS-3 (23.5 m.) and PAN (5.8m.) (PCA)

Water
Barrenland
Vegetation

Slide 1
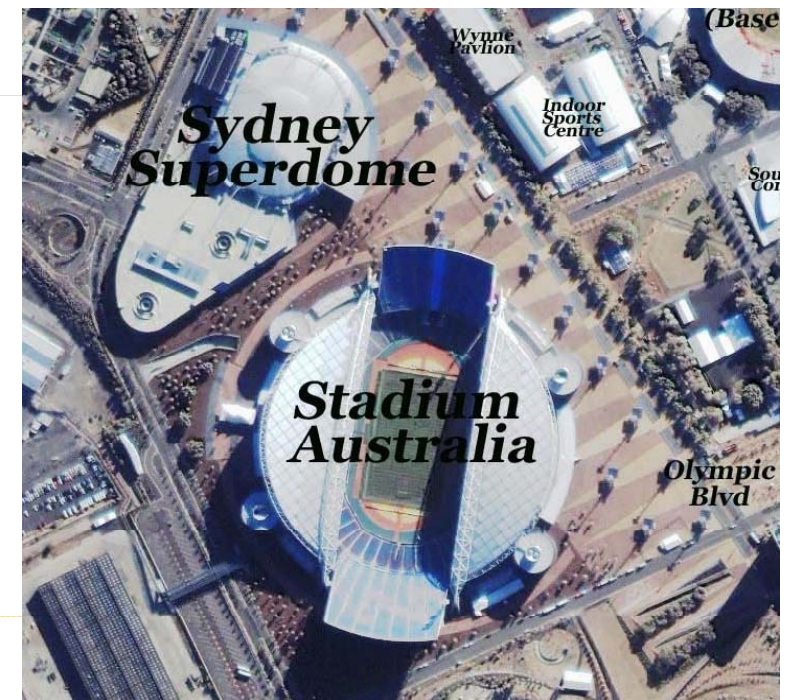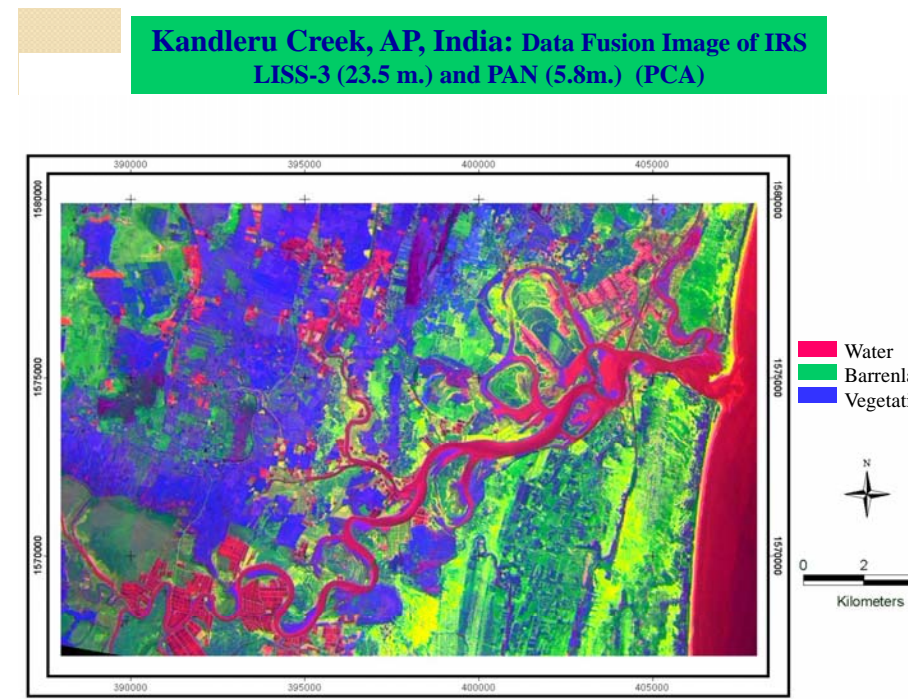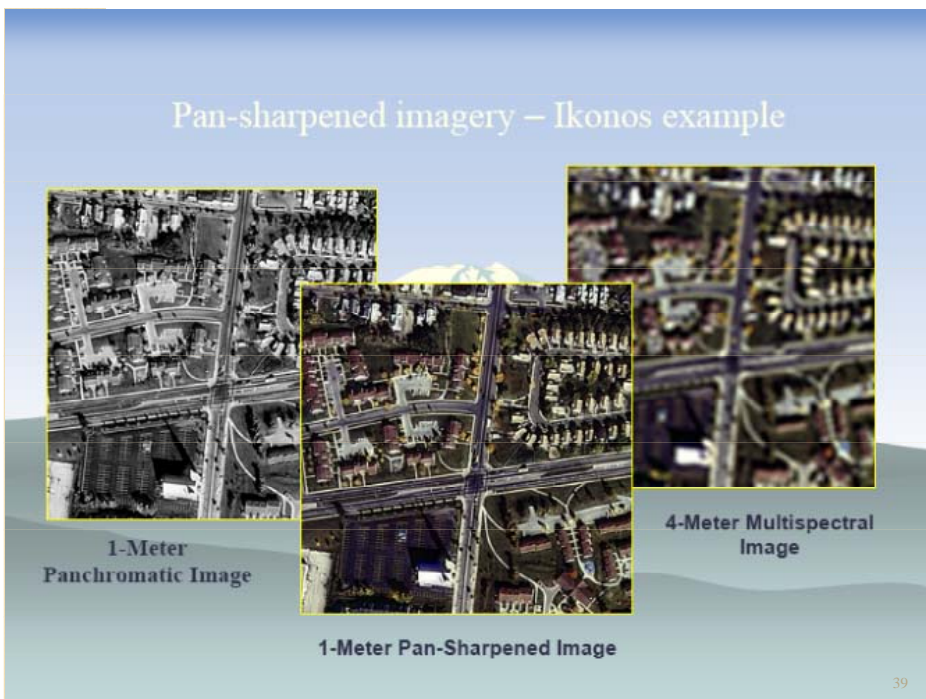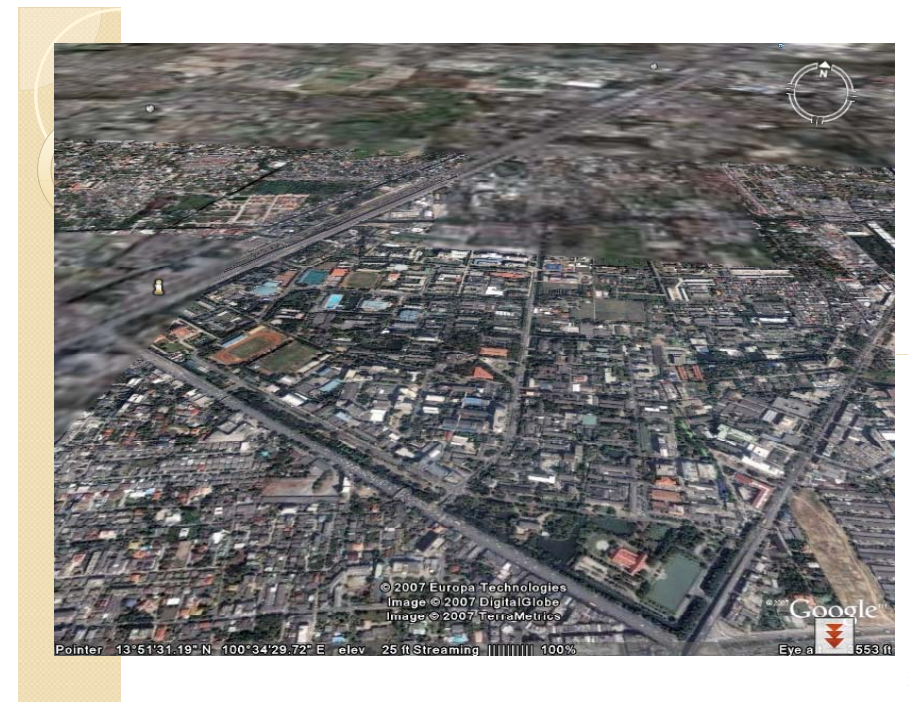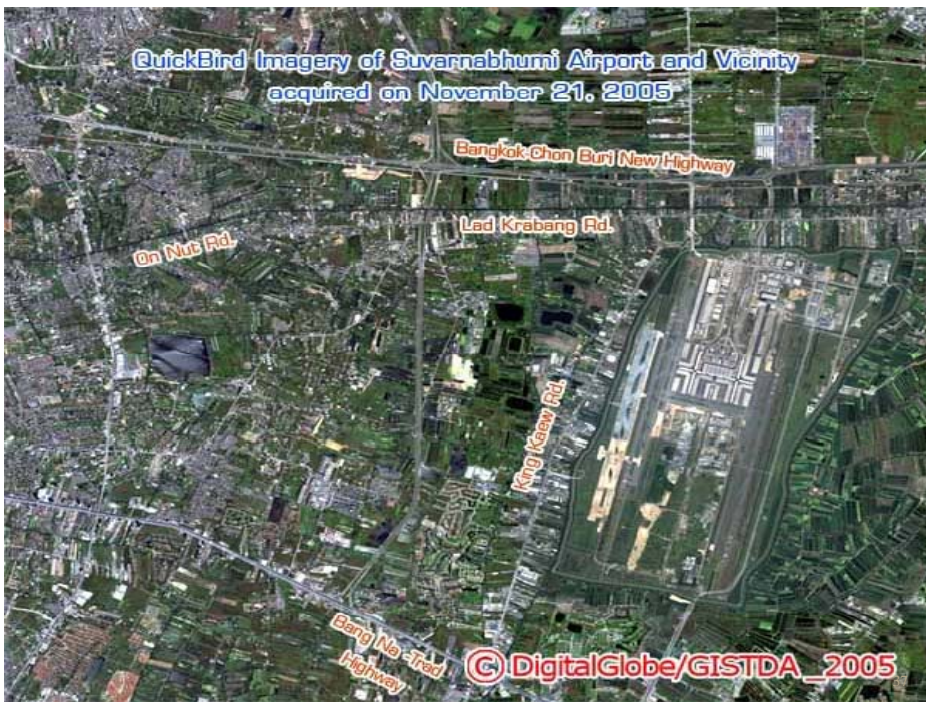
Key activities (4M) can be enhanced through the use of GIS

Measure

Map Environment

Monitor Development Four M's

Model Change space and time ← GIS

Alternative action , process operating
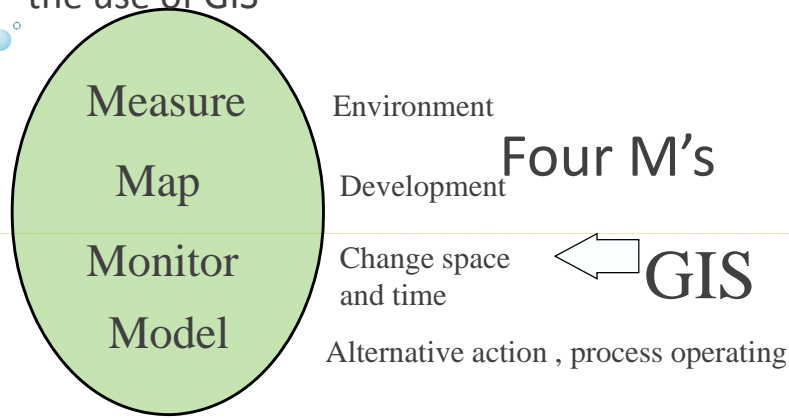
GIS are a means of integrating spatial data acquired at different Scale , times and different format
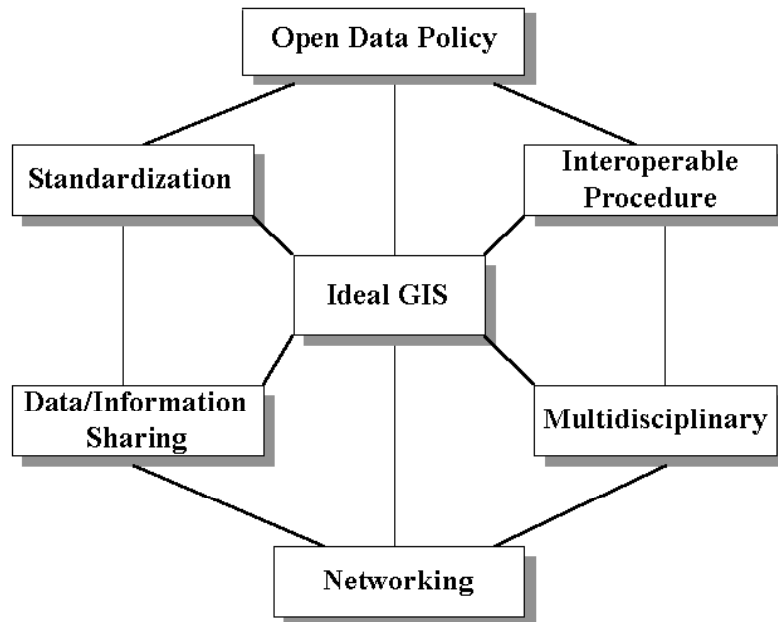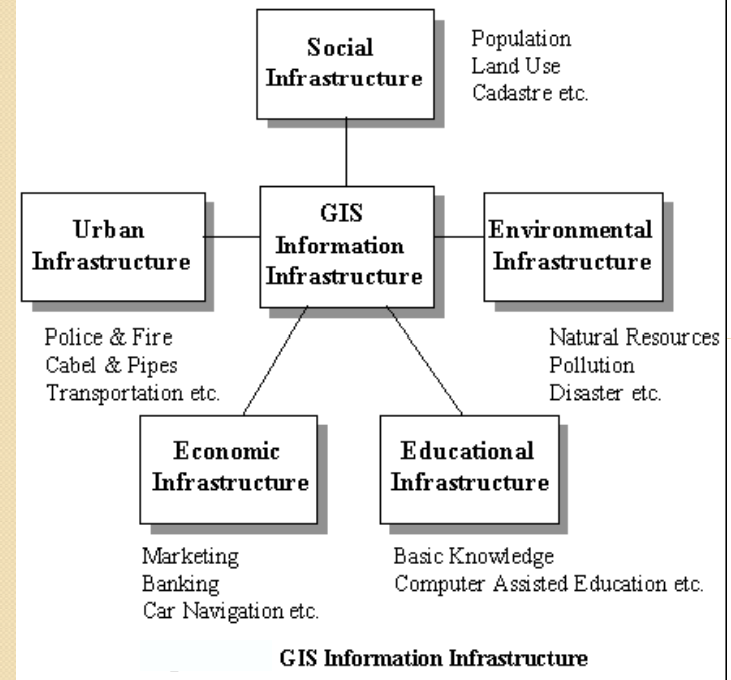
42

Slide 2

Professional Packages

- Arc / INFO
- Arc GIS
- Arc View
- ILWIS
- ERDAS
- IDRISI
- MAPINFO
- GRASS

RDBMS
↓

- ORACLE
- d BASE

42

Slide 3

Data Collection

Real World → Data Source

Action Taken Input of Data

Users Data Management

Information for decision making

Analysis Data Retrieval & Analysis

43

Slide 4
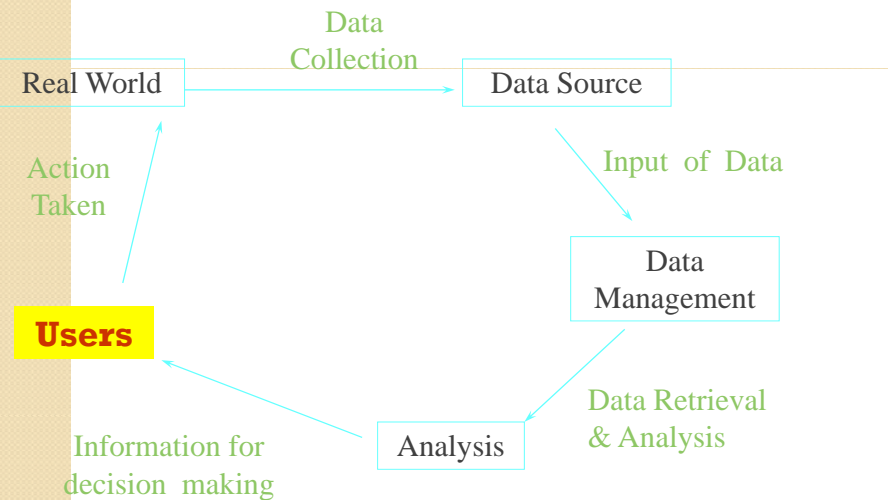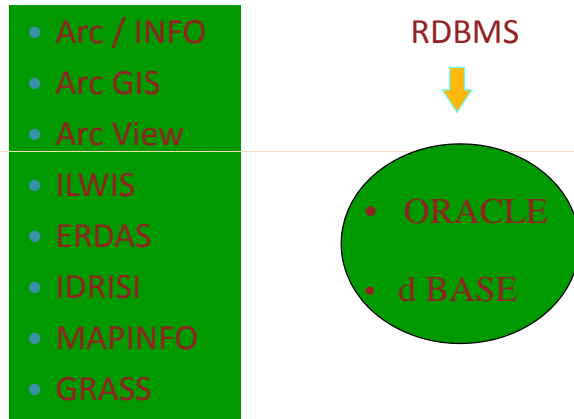
Major Areas of GIS Applications

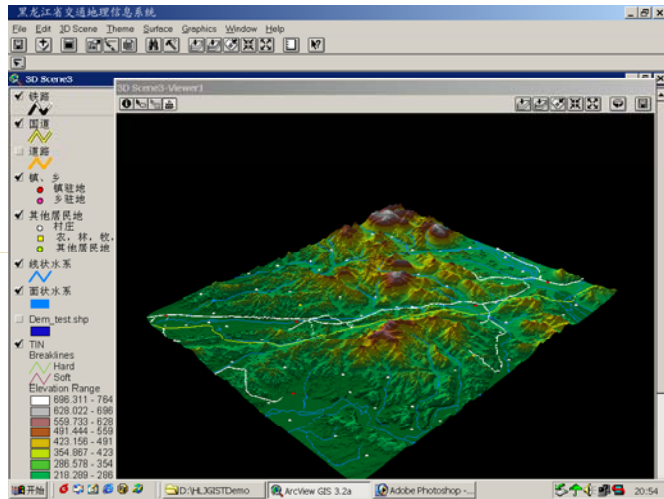| Area	GIS Applications
Facilities Management	locating underground pipes & cables planning facility maintenance telecommunication network services energy use tracking & planning
Environment and Natural Resources Management	suitable study for agricultual cropping management of forests, agricultual lands, water resources, wetlands etc. environmental impact analysis disaster management and mitigation waste facility site location
Street Network	car navigation (routing & scheduling) locating houses and streets site selection ambulance services transportation planning
Planning and Engineering	urban planning regional planning route location of highways development of public facilities
Land Information System	cadastre administration taxation zoning of land use land acquisition

GIS as an Information Infrastructure

Information has become a key issue in the age of computer, space technology and multimedia, because the information infrastructure contributes to the quality of life as in the followings Infrastructure.

Social infrastructure...   better society
Environmental infrastructure...   better management
Urban infrastructure....   better life
Economic infrastructure.......   better business
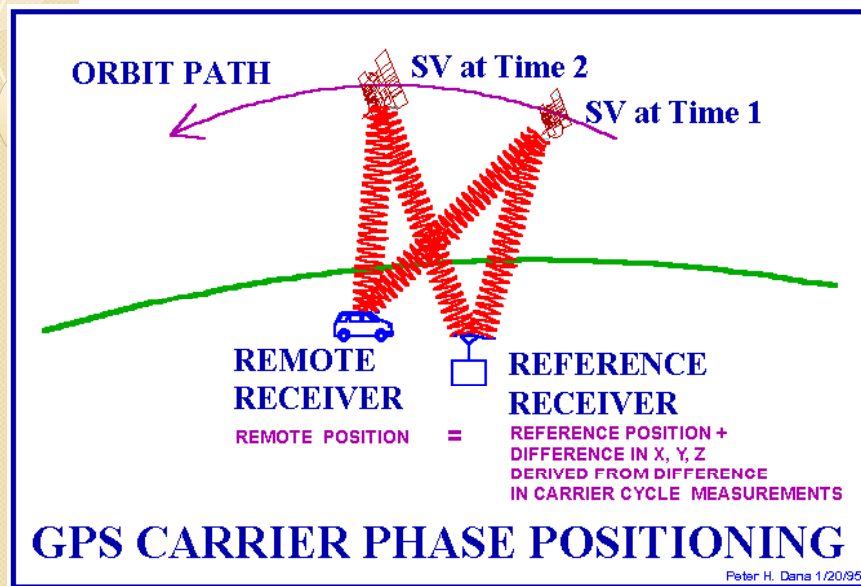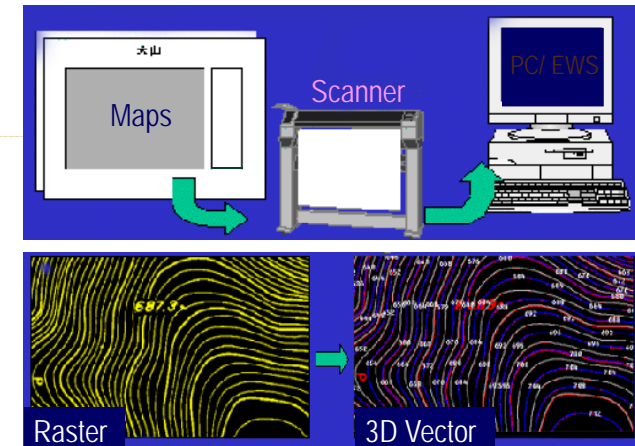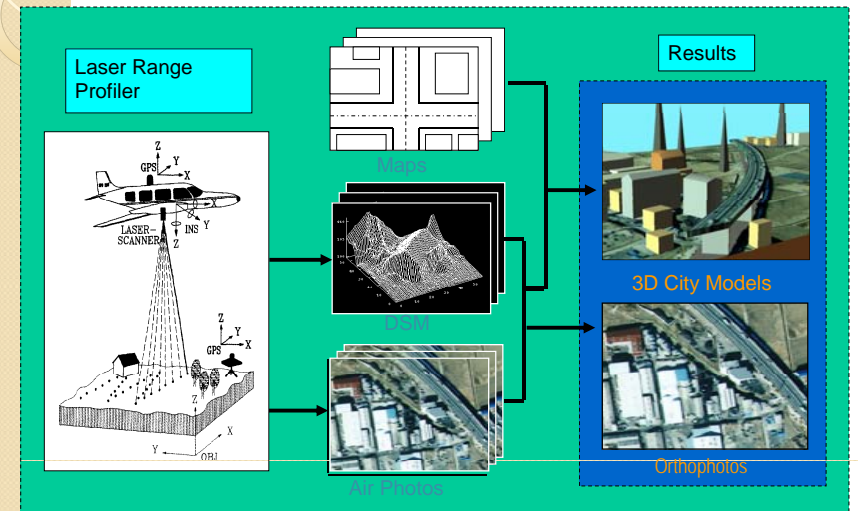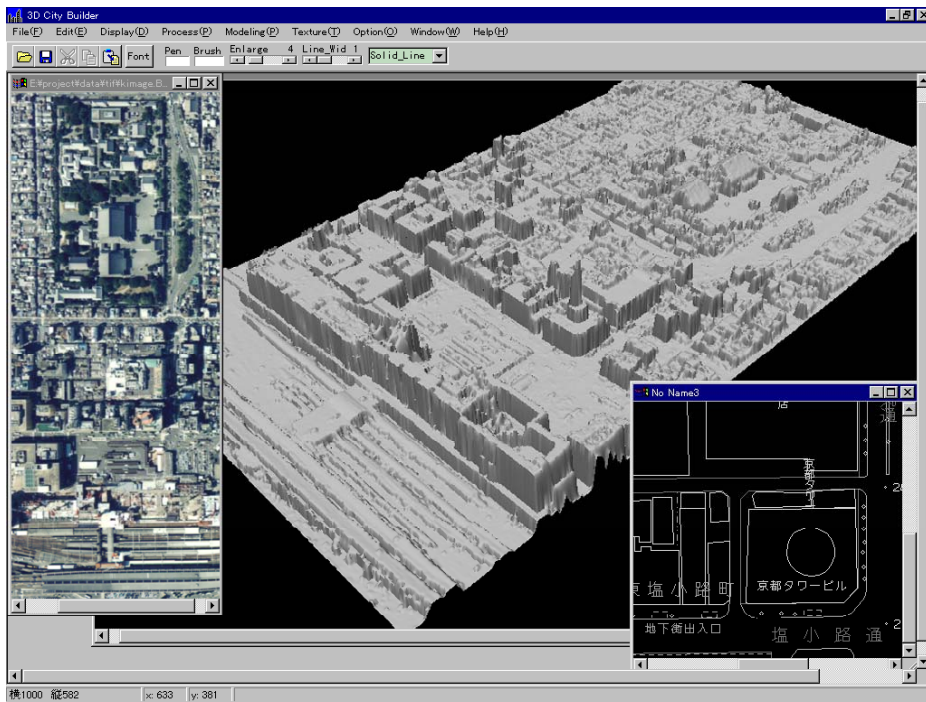Educational infrastructure......   better knowledge

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GIS Information Infrastructure

Social Infrastructure — Population, Land Use, Cadastre etc.

Urban Infrastructure — Police & Fire, Cabel & Pipes, Transportation etc.

GIS Information Infrastructure

Environmental Infrastructure — Natural Resources, Pollution, Disaster etc.

Economic Infrastructure — Marketing, Banking, Car Navigation etc.

Educational Infrastructure — Basic Knowledge, Computer Assisted Education etc.

Open Data Policy

Standardization

Interoperable Procedure

Ideal GIS

Data/Information Sharing

Multidisciplinary

Networking

Ideal GIS

GIS APPLICATION

INTRODUCTION

- Our Goal ➝ Automated Understanding Raster Maps

Maps | Scanner | PC/ EWS

Raster | 3D Vector

GPS CARRIER PHASE POSITIONING

Peter H. Dana 1/20/95

System Outline

Laser Range Profiler

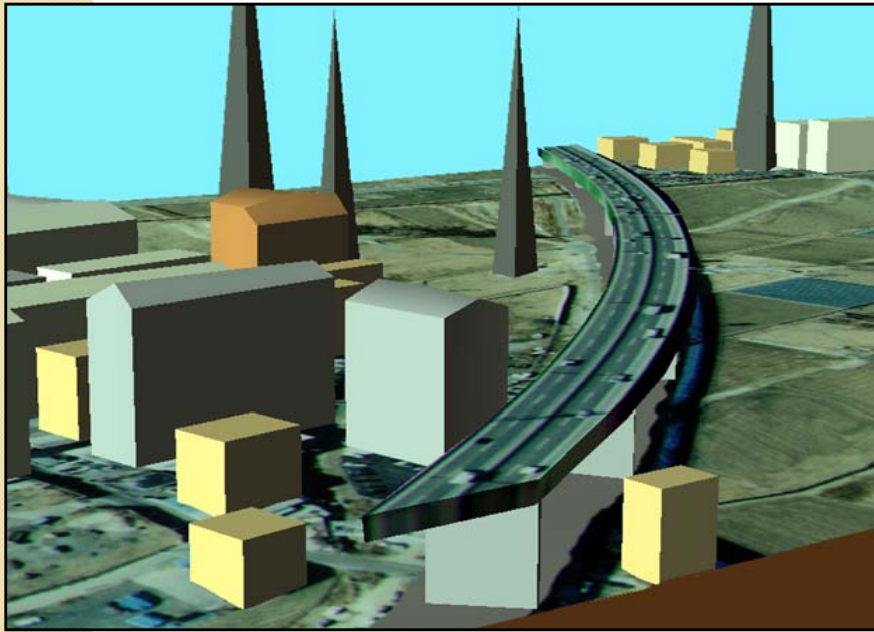Results

Maps

DSM

3D City Models

Air Photos

Orthophotos

Mobile based Laser Range Scanning

Thus we finish the introduction to GIS.

Lets think about the potential of GIS.......

GIS ONLINE:
1. http://www.innovativegis.com/basis/primer/concepts.html
2. http://www.sli.unimelb.edu.au/gisweb/menu.html